Photo: K. Turkington

Alberta **Clubroot** Management Plan

Developed by:

Alberta Clubroot Management Committee

Revised May 2010

Government of Alberta

AGDEX 140/638-2

Clubroot Disease Overview

What is it?

Clubroot is a serious soil-borne disease of canola, mustard and other crops in the cabbage family. Cole crop vegetables, for example, broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, kale, kohlrabi, radish, rutabaga and turnip, are susceptible to clubroot, as are many cruciferous weeds, for example, wild mustard, stinkweed and shepherd's purse.

What does it look like?

As the name of this disease suggests, roots of infected plants may have a club-like appearance; however, overall symptoms will vary depending on the growth stage of the crop when it becomes infected. Infection at the seedling stage can result in wilting, stunting and yellowing symptoms by the late rosette to early podding stage, while premature ripening or death can be observed in canola or mustard plants nearing maturity. Plants infected at later growth stages may not show wilting, stunting or yellowing, but may still ripen prematurely, and seeds may shrivel, thus reducing yield and quality (oil content).

Can other diseases or disorders be confused with clubroot?

Above ground symptoms of clubroot may be confused with drought, nutrient deficiencies or other diseases, so suspect plants should be carefully dug from the soil to check for typical clubroot galls on the roots. Swellings of unknown origin called hybridization nodules are occasionally seen on canola roots and can be confused with young clubroot galls. These nodules are more spherical and firmer than clubroot galls and do not decay when mature as clubroot galls do. Exposure to phenoxy herbicides can also result in swellings on lower stems and roots of canola, mustard and cole crop vegetable plants, but these malformations usually lack the large size and lobed appearance of typical clubroot galls.

What causes it?

Clubroot is caused by a microscopic, soil-borne plant pathogen called *Plasmodiophora brassicae*. The clubroot pathogen is classified as a Protist, a group of organisms with characteristics of plants, fungi and protozoans. The life cycle of the clubroot pathogen is illustrated in the Alberta Agriculture and Rural Development factsheet *Clubroot Disease of Canola and Mustard*, Agdex 140/638-1, available online at: http://www.agric.gov.ab.ca/app21/infopage

Where was it first found in Alberta?

Clubroot was first reported on broccoli, cabbage and cauliflower in a few home gardens in the Edmonton area in the mid 1970s. The first economically important infestation in Alberta was observed on Chinese cabbage in a market garden near Edmonton in 2001. Clubroot was first detected in canola in Alberta in Sturgeon County northwest of Edmonton in 2003.

Where did it come from?

The original source of the clubroot infestation in Alberta is unknown, but it may have been accidentally introduced by early settlers who may have brought infected vegetables with them from other areas of Canada or the US where clubroot was already established.

Why is it of concern?

Most varieties of canola, mustard and cole crop vegetables currently being grown in Alberta are highly susceptible to clubroot. This disease is capable of significantly reducing yield and quality, and may destroy a crop if infestation levels are high. Swedish researchers found that infestations in canola fields nearing 100 per cent affected plants caused about 50 to 80 per cent yield loss, while infestations of 10 to 20 per cent led to 5 to 10 per cent yield loss. This outcome is similar to sclerotinia stem rot infection in canola, where a general rule of thumb is that estimated yield loss is half of the percentage of infected stems. A few cases of total crop loss, that is, not worth combining, have been seen in central Alberta.

How long can it persist in the soil?

The resting spores of *P. brassicae* are extremely long lived and may survive in soil for up to 20 years according to Swedish research. Resting spore longevity is a key factor contributing to the seriousness of the clubroot disease, especially under short crop rotations. Clubroot is not a phytosanitary issue affecting international trade of canola or mustard.

How can it be spread?

In Alberta, clubroot is being spread mainly through soil infested with resting spores. Infested soil can be carried from field to field by farm machinery, especially tillage equipment, and can also be moved by wind and water erosion. Seed of various crops, as well as hay and straw, can also become contaminated with resting spores via dust or earth tag when they are grown in clubroot-infested fields.

What is being done about it?

In spring 2007, clubroot was added as a declared pest to Alberta's *Agricultural Pest Act*. This Act is the legislative authority for the enforcement of control measures for declared pests in Alberta. Annual surveys of canola, mustard and/or cole crop vegetables have been carried out to determine the location of infested fields in the main production areas for these crops. An annual incidence map is published on Alberta Agriculture's website (www.agriculture.alberta.ca). Researchers from many agencies, including the University of Alberta, Alberta Agriculture and Rural Development, and Agriculture and Agri-Food Canada, have many active research projects on clubroot. Private breeding programs have started to release clubroot-resistant canola varieties for western Canada.

What is the current state of clubroot in Alberta?

By the end of 2009, clubroot was present in 17 municipalities in Alberta, mainly in central Alberta. For a map showing infested municipalities go online to: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/prm12945. Clubroot has the potential to spread to and become established in many of the traditional canola-growing areas of western Canada.

Clubroot Management Plan Objective

The objective of the Clubroot Management Plan is to minimize yield losses due to clubroot and reduce the further spread and buildup of clubroot in canola, mustard and market garden vegetable fields in Alberta.

Regulatory Status

Alberta's *Agricultural Pests Act* (APA) is the legislative authority for the enforcement of control measures for declared pests in Alberta. Clubroot was added as a declared pest to the APA in April 2007.

The Minister of Alberta Agriculture and Rural Development is responsible for this Act; however, enforcement is the responsibility of provincial municipalities. Agricultural Fieldmen are responsible for enforcing pest control measures in their respective municipalities.

Pest inspectors may be appointed by the local municipality or by the Minister of Agriculture and Rural Development. Agricultural Fieldmen are pest inspectors under the *Agricultural Pests Act*. Inspectors have the power to enter land at a reasonable hour, without permission, to inspect for pests and collect samples. For a contact list of Agricultural Fieldmen and assistants in Alberta, check online at: http://www.aaaf.ab.ca/images/stories/aaaf_members_complete.pdf

The owner or occupant of land has the responsibility of taking measures to prevent the establishment of any pest on land, property and livestock and to control or destroy all pests in the land or property.

Control measures for clubroot are specified in this management plan. It is important to understand that these control measures represent an acceptable standard that is to be applied in all municipalities across the province. Municipalities can enhance the standard within their own jurisdictions.

Factors Favouring the Spread of Clubroot in Alberta

Resting spores can be spread from field to field via contaminated soil on agricultural, petroleum industry and construction equipment and machinery. Soil tillage equipment represents the greatest risk of spreading the disease as soil is frequently carried on shovels, discs, openers, frames and tires. Clubroot surveys in Alberta have found that most new infestations begin at or near the field access, which indicates that contaminated equipment is the predominant spread mechanism.

Other secondary methods of spread could include movement of soil with water or wind and as soil attached to seed (earth tag), hay, straw or greenfeed.

Resting spores are extremely long lived, with a half-life of about 4 years, but may survive in soil for up to 20 years. The longevity of the resting spores is a key factor contributing to the seriousness of the disease, especially under tight canola rotations.

All land users, including growers, custom agricultural services, oil and gas industry operators, construction and transportation companies, recreational vehicle users, etc., need to continue their diligence in removing potentially contaminated soil from vehicles, machines and equipment prior to leaving fields. The removal is crucial to prevent the movement and introduction of clubroot to clean fields and to reduce the widespread distribution of spores within infested fields, which could accelerate the breakdown of resistance within clubroot-resistant canola varieties.

Management Plan Rationale

Clubroot in Alberta is managed through a proactive program that utilizes and prolongs the durability of clubroot-resistant canola varieties in combination with continuing efforts to prevent the further spread of this pathogen in the province. The program will include both an industry/public awareness program and a disease management plan.

The long-term goal of this management plan is to minimize canola yields losses through the judicious use of resistant varieties and to reduce the further spread of clubroot in Alberta.

Best Management Practices

1. Use clubroot-resistant varieties when growing canola in areas where the disease is established. Alternate growing clubroot-resistant varieties with different sources of resistance.
2. Use long rotation breaks (three years or more) between canola crops. Although crop rotation will not prevent the introduction of clubroot to clean fields, it will lower subsequent disease severity and reduce other diseases, such as blackleg. Canola growers in high risk situations (confirmed clubroot in the field or area) should follow traditional canola rotation recommendations (one canola crop every four years) using clubroot-resistant varieties. The one in four-year rotation recommendation using resistant varieties is designed to slow down resistance breakdown, which has been documented in other parts of the world.
3. Volunteer canola and cruciferous weeds must be controlled in infested fields to prevent more than three weeks of growth to avoid the production of new resting spores on these host plants.
4. Practice good sanitation (cleaning and disinfection) of machinery and equipment to restrict the movement of potentially contaminated soil. This approach will also help reduce the spread of other diseases, insects and weed seeds. Resting spores can be spread via contaminated soil. Moderate to

high infestations will leave high spore concentrations in soil on field machinery, thus sanitation is very important in these situations. All producers should follow the practice of cleaning soil and crop debris from field equipment before transport from all fields. Cleaning equipment involves knocking or scraping off soil lumps and sweeping off loose soil.

- For risk averse producers or for fields with heavy infestations, additional cleaning steps will slightly decrease the risk of spread, but these steps involve considerably more work and expense:
  - After removal of soil lumps, wash equipment with a power washer, preferably with hot water or steam.
  - Finish by misting equipment with weak disinfectant, for example, a 1 to 2 per cent active ingredient bleach solution. Use of a disinfectant without first removing soil is not recommended because soil inactivates most disinfectants.
  - Seed an area to grass near the field exit to clean off equipment more effectively.

5. Use direct seeding and other soil conservation practices to reduce erosion. Resting spores can also readily move in soil transported by wind or water erosion. Reducing the amount of tillage on any given field will reduce the spread of the organism within the field and to other fields.
6. Minimize vehicle and equipment traffic to and from fields.
7. In situations where fields are lightly infested only near the current access, create a new exit at another distant edge of the field if possible.
8. Scout canola fields regularly and carefully. Identify causes of wilting, stunting, yellowing and premature ripening – do not assume anything!
9. Avoid the use of straw, hay or greenfeed, silage and manure from infested or suspicious areas. Clubroot spores may survive through the digestive tracts of livestock.
10. Avoid common untreated seed (including canola, cereals and pulses). Earth tag on seed from infested fields could introduce resting spores to clean fields. The effect of current seed treatment fungicides on resting spore viability on seed is currently being studied.

However, the risk of spreading clubroot through contaminated seed or plant material is much lower than the risk of transporting contaminated soil on field equipment.

Responsibilities

Alberta Agriculture and Rural Development (ARD)

- Pest Surveillance Branch of ARD will coordinate the Alberta Clubroot Management Plan and do the following:
  - provide regulatory consultation and training
  - prepare and provide technical information on clubroot control recommendations and variety resistance stewardship to inspectors and others in the field
  - assist in educating the agriculture industry, oil industry and general public about clubroot and the threat it represents to Alberta
  - inform other industry sectors, such as the agricultural retail industry, environmental companies, custom applicators, petroleum, construction and transportation industries, and landscaping companies, about equipment sanitation requirements to reduce clubroot spread within and between municipalities

Agricultural Service Boards (ASB)

- ASBs will provide support and resources to the Agricultural Fieldmen in carrying out their duties, and the Agricultural Fieldmen will do the following:
  - actively survey for clubroot if canola or mustard is being grown in their municipality – follow-up surveys on infested land should be conducted to monitor for resistance breakdown in newly introduced resistant canola varieties
  - provide recommendations and information to farmers on clubroot prevention and management, especially the stewardship of variety resistance
  - enforce control measures as necessary to meet the objectives of the Alberta Clubroot Management Plan
  - maintain records of infestations and provide information on infested land locations to potential land renters, landowners, oil and gas companies and other parties with a financial interest, under provisions of the *Agricultural Pest Act* and the Pest and Nuisance Control Regulation (Section 10)
  - assist in educating the Alberta agriculture industry about clubroot and the threat it represents to Alberta

Landowners/Occupants

- take measures such as vehicle and equipment sanitation as well as proper crop rotation to prevent the establishment of clubroot on their land and to minimize the spread of clubroot to other land or property
- grow resistant varieties when clubroot is present or is known to be present in the area and follow a four-year rotation to deter resistance breakdown
- observe and follow all management practices to meet the objectives of the Alberta Clubroot Management Plan

Agricultural Retail and Service Industry (pesticide/fertilizer retailers, custom equipment leasing, consulting agronomists, Canola Council of Canada, etc.)

- take measures such as equipment cleaning and disinfection to prevent the establishment of clubroot and to minimize the spread of clubroot to other land and property
- assist in educating the agriculture industry about clubroot, the threat it represents to Alberta, and the value of extended rotations for minimizing variety resistance breakdown

Custom Equipment Operators

- take measures such as equipment sanitation to prevent disease establishment and to minimize the spread of clubroot to other land and property
- assist in educating producers and others in the agriculture industry about clubroot and the threat it represents to Alberta's canola industry

Energy (Oil, Gas, Pipeline, Seismic), Construction (Earthmoving, Landscaping) and Transportation (Trucking) Companies Operating on Agricultural Land

- take measures to prevent disease establishment and to minimize the further spread of clubroot to other land and property – examples of such measures include the following:
  - clean equipment when leaving infested sites or areas
  - remove/stockpile topsoil on leases with clubroot before moving other equipment on-site
  - avoid equipment traffic during wet conditions in infested areas
- prepare and follow clubroot protocols for staff and contractors; for example, in 2008, the Canadian Association of Petroleum Producers published best management practices for clubroot disease (http://www.capp.ca/getdoc.aspx?DocId=139848&DT=PDF)
- assist in educating the petroleum, construction and transportation industries about clubroot and the threat it represents to agriculture in Alberta

Researchers

- conduct research to increase understanding of clubroot biology and management
- communicate research findings to extension personnel and other stakeholders
- serve as scientific advisors to the Clubroot Management Committee
- make recommendations to producers and the agricultural service industry, as needed, based on scientific knowledge and experimental evidence

Clubroot Management Committee

- provide a forum to represent the interests and views of the agriculture and oil and gas industries in Alberta and western Canada regarding the management of clubroot
- recommend management strategies for clubroot for inclusion in the Alberta Clubroot Management Plan
- assist in educating the agriculture, oil and gas industries in western Canada about clubroot and the threat it represents to canola and cole crop production
- evaluate and revise the Alberta Clubroot Management Plan as required

Additional Resources

Clubroot Disease of Canola and Mustard, Agdex 140/638-1, Alberta Agriculture and Rural Development

Clubroot of Crucifers Control Strategies, Agriculture and Agri-Food Canada, Horticulture

Clubroot Management Committee Contact List – attached

Clubroot Management Committee Contact List

Murray Hartman (chair)
Alberta Agriculture and Rural Development
murray.hartman@gov.ab.ca

Gayah Sieusahai (vice-chair)
Alberta Agriculture and Rural Development
gayah.sieusahai@gov.ab.ca

Darrel Armstrong
Pioneer Hi-Bred Production
darrel.armstrong@pioneer.com

Jason Bullock
MD of Taber
jbullock@mdtaber.ab.ca

Don Christensen
AB Farm Fresh Producers Association
dlchrist@mcsnet.ca

Patrick Delaney
Petroleum Services Association of Canada
pdelaney@psac.ca

Emile deMilliano
Viterra
emile.demilliano@viterra.ca

Clifford Goerz
Parkland County ASB
cgoerz@parklandcounty.com

Bruce Greenfield
Energy Resources Conservation Board
bruce.greenfield@ercb.ca

Ron Howard
Alberta Agriculture and Rural Development
ron.howard@gov.ab.ca

Sheau-Fang Hwang
Alberta Agriculture and Rural Development
sheau-fang.hwang@gov.ab.ca

Trent Keller
County of Athabasca
tkeller@athabascacounty.com

Jody Klassen
Alberta Canola Producers Commission
jody.klassen@canola.ab.ca

John Mayko
Canola Council of Canada
maykoj@canola-council.org

Trevor Miller
Cargill
Trevor_A_Miller@cargill.com

Gary Sargent
Canadian Association of Petroleum Producers
gary.sargent@capp.ca

Warren Sekulic
Birch Hills County
WarrenS@birchhillscounty.com

Shayne Steffen
Ponoka County
shaynesteffen@ponokacounty.com

continued on next page

Stephen Strelkov
University of Alberta
stephen.strelkov@ales.ualberta.ca

Lee Taylor
Quicksilver Resources Canada Inc.
LTaylor@qrinc.ca

Ward Toma
Alberta Canola Producers Commission
ward.toma@canola.ab.ca

Aimee Wonsik
Municipal District of Wainwright
asb@mdwainwright.ca